

LIVVkit: An extensible, python-based, land ice verification and validation toolkit for ice sheet models

Objectives

- **Provide a community tool to perform robust verification and validation of ice sheet models, both for stand-alone models and models coupled to an Earth system model.**

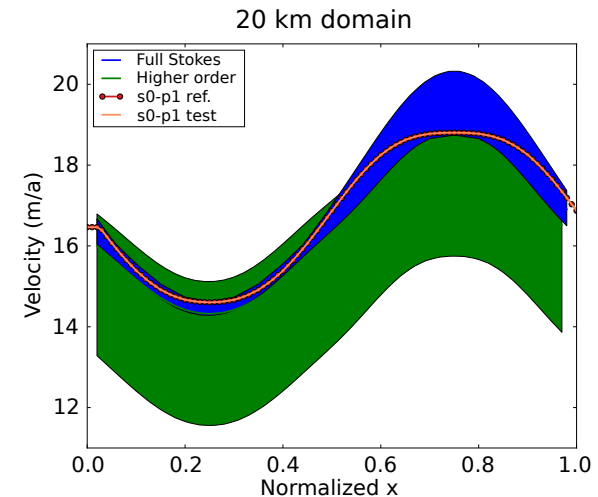
Impact

- LIVVkit is the first verification and validation testing suite developed for ice sheet models that covers all four aspects of V&V and has a design focused on both **building confidence in and enhancing the credibility of ice sheet models.**

Accomplishments

- Provides numerical verification, software verification, performance validation, and physical validation analyses on many platforms; from laptops to HPCs.
- Designed to be easily extensible by developers to new methods of analysis, models, and observations.
- Intended to help developers build confidence in their models and enhance the credibility of ice sheet models overall.
- LIVVkit 2.0.0 released Aug. 2016 under an open source license at <https://github.com/LIVVkit/LIVVkit>.

Kennedy, J.H., A.R. Bennett, K.J. Evans, S. Price, M. Hoffman, W.H. Lipscomb, J. Fyke, L. Vargo, A. Boghazian, M. Norman, P. Worley (2017), LIVVkit: An extensible, python-based, land ice verification and validation toolkit for ice sheet models. JAMES, DOI: 10.1002/2017MS000916



A comparison of CISM ISMIP-HOM C test (orange line) with a 20 km domain length and the CISM reference (red dots) with the ISMIP-HOM results (blue region for full Stokes models, green region for higher-order models). This figure shows the norm of the ice sheet surface velocity across the bed oscillation.



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Summary

To address the pressing need to better understand the behavior and complex interaction of ice sheets within the global Earth system, significant development of continental-scale, dynamical ice sheet models is underway. Concurrent to the development of the Community Ice Sheet Model (CISM), the corresponding verification and validation (V&V) process is being coordinated through a new, robust, Python-based extensible software package, the Land Ice Verification and Validation toolkit (LIVVkit). Incorporated into the typical ice sheet model development cycle, it provides robust and automated numerical verification, software verification, performance validation, and physical validation analyses on a variety of platforms, from personal laptops to the largest supercomputers. LIVVkit operates on sets of regression test and reference datasets, and provides comparisons for a suite of community prioritized tests, including configuration and parameter variations, bit-for-bit evaluation, and plots of model variables to indicate where differences occur. LIVVkit also provides an easily extensible framework to incorporate and analyze results of new intercomparison projects, new observation data, and new computing platforms. LIVVkit is designed for quick adaptation to additional ice sheet models via abstraction of model specific code, functions, and configurations into an ice sheet model description bundle outside the main LIVVkit structure. Ultimately, through shareable and accessible analysis output, LIVVkit is intended to help developers build confidence in their models and enhance the credibility of ice sheet models overall.

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